

**MONTHLY PROGRESS REPORT
SLURRY/MICRO-SURFACE MIX DESIGN PROCEDURE
OCTOBER 2003**

To:	T. Joe Holland, CALTRANS
Contract No.:	CALTRANS 65A0151
Contract Period:	June 30, 2003 – Nov. 30, 2007
Agency:	Fugro-BRE, Inc.
Prepared By:	Jim Moulthrop, Principal Investigator
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PROJECT OVERVIEW

The overall goal of this research is to improve the performance of slurry seal and micro-surfacing systems through the development of a rational mix design procedure, guidelines, and specifications.

Phase I of the project has two major components: the first part consists of a literature review and a survey of industry/agencies using slurry and micro-surfacing systems, the second part deals with the development of a detailed work plan for Phases II and III.

In Phase II, the project team will evaluate existing and potential new test methods, evaluate successful constructability indicators, conduct ruggedness tests on recommended equipment and procedures, and prepare a report that summarizes all the activities undertaken under the task.

In Phase III, the project team will develop guidelines, specifications, and a training program; and will provide expertise and oversight in the construction of pilot projects intended to validate the recommended design procedures and guidelines. All activities of the study will be documented in a Final Report.

CURRENT MONTH WORK ACTIVITIES AND COMPLETED TASKS

PHASE I LITERATURE SEARCH AND WORK PLAN DEVELOPMENT

Task 1 – Literature Review and Industry Survey

Literature Review

Completed: The team has completed the review and summarization of the ASTM D 3910 and D 6372 standards, the ISSA Performance Guidelines A105 and A143, and of several papers by Robert Benedict. In addition, the French and German standards for slurry seals have been reviewed, but a write-up has yet to be developed. A general outline for the draft literature review report has been developed and is used to organize the reviewed material:

- Introduction
- Extent of Use Worldwide
- Current Mix Design Procedures
- Laboratory Tests
- Critical Factors that Relate to Performance
- Performance of Existing Projects
- Existing Guidelines and Specifications
- Failure Modes
- Benefits and Limitations
- Intended Use and Expectations
- Proposed Framework for Performance Based Design Procedure

Note that the Task I Report will contain two additional major sections - the results of the survey questionnaires and the work plans developed for Phases II and III of the project.

Ongoing: The literature review process continued in October with the review and summarization of more documents from the initial list of references. Of these, the review of the Texas Transportation Institute (TTI) reports (0-1289-1 & 1289 2-F) has been completed and several other documents are being reviewed. An updated list of references and their status is provided in Table 1. As mentioned in the September report, most of the data reviewed during the literature search is stored in a database for easy access and use in the later phases of the project. Database population activities continued this month, especially with performance data from the TTI reports.

Table 1. Literature Sources

Source	Available	Reviewed
ASTM D3910-98 and ASTM D6372-99 Practice for Design, Testing and Construction of Micro-surfacing	Yes	Yes
ISSA procedures for Slurry Seal Mix Design (A105) and Micro-surfacing (A143)	Yes	Yes
TTI Reports 0-1289-1 & 1289 2-F	Yes	Yes
International Slurry Surfacing Association Conference Proceedings	Yes	In Progress
Papers by Robert C. Benedict	Yes	In Progress
Transportation Research Board Publications, Research in Progress	Yes	
European Standards EN 12274-1 to 12274-8 Slurry surfacing Test methods Part 1 to Part 8.	No	
Transportation Research Laboratory Standards (UK)	Yes	
Austroroads – Guide to the Selection and Use of Bitumen Emulsions	Yes	
German Standards	Yes	Yes
French Standards	Yes	Yes
CALTRANS Slurry Study	Yes	In Progress
Technical Guideline: The use of Modified Bituminous Binders in Road Construction. Asphalt Academy c/o Transportek, CSIR	Yes	In Progress

New: This month the project team commenced the review of Caltrans's *Microsurfacing Pilot Study 2001*.

Planned: The team will attempt to acquire the European standards EN 12274-1 to 12274-8 Slurry surfacing Test methods Part 1 to Part 8. Requests have been made to contacts in Europe through the International Slurry Surfacing Association (ISSA) to obtain these standards. The translation of the German procedures will be completed by Ms. Goldman.

Industry and Agency Surveys

Completed: Following discussion with members of the project team and CALTRANS, three questionnaires were designed:

- AASHTO LISTSERVE: for agencies using the AASHTO LISTSERVE link.
- Industry: for contractors and manufacturers in the United States and the international slurry surfacing and microsurfacing industry.
- Advisory Panel: for the advisory panel contractors.

The three proposed survey questionnaires were submitted in the August 2003 monthly report and discussed at the videoconference kickoff meeting on September 22, 2003. Based on the comments and suggestions of the participants at the videoconference, the questionnaires were revised and submitted with the September 2003 report.

New: At the request of the client, the three questionnaires have been revised again and will be sent to the intended recipients in early November. The revised questionnaires have check box and text fields inserted for processing electronically. They are submitted as separate files accompanying this report.

Planned: After the responses to the questionnaires are received, the data will be analyzed to identify the main concerns of agencies, industry, and the advisory board. This analysis will be part of the Task 1 Literature Review Report.

Task 2 – Work Plans for Phases II and III

Completed: One of the activities pursued under this task was the review of potential test methods for slurry seal and microsurfacing mix designs. The emphasis was on the humidity variation of the wet cohesion test for potential use in examining curing characteristics under humidity, night, and low temperature conditions.

Continuing discussions on the Phase II Work Plan were conducted by Mr. Holleran and Ms. Goldman. The provisional outline of the Phase II plan is presented below:

Step 1 Materials Testing

- Screen materials to allow agency to check that correct materials were used.
- No changes for aggregate testing or specifications at this stage.

- Binder recovery method to be ASTM vacuum distillation, Caltrans method, or another appropriate method that does not affect the original binder properties.
- Binder specification to be on base binder and DSR results for 10°C and 35°C to establish thermal susceptibility only (measure $G^*\sin \Delta$ for the existing commercial range of emulsion binders). Note: The project team is debating these temperatures.
- Establish minimums for recovered binder and allow a maximum percentage change to account for aging or stiffness.
- Wet stripping: Technical Bulletin (TB)-114 would be retained.

Step 2 Mixing Characteristics

- Trial mixes using hand mixing as per existing ISSA procedure from TB-113.
- German mix cohesion testing on selected mixes to establish a mixing index that will allow use at given temperatures and humidity on standard equipment (this will require standard mixtures being used from known acceptable field mixes).
- Workability Index: This will be based on consistency and spreadability of the mix in a spreader box under different conditions and specifying a maximum cohesion value at a given time.

Step 3 Cohesion Build Up after Spreading

- Modified sample preparation protocols to take into account night, humidity, and temperatures of cure.
- Modified TB-139 with a new machine measuring torque instrumentally with application of force and response measured either in compression or with confined samples in rubber.
- Test would define:
 - Cohesion at trafficability
 - Cohesion at 24 hours
 - Optimum binder content
- Wet Track Abrasion Test (WTAT) [test with different treatments, e.g., soaking for water resistance] with modification. Consideration will be given to looking at low and high temperature testing. Load variations on the wheels could be used for higher traffic simulations. Variable cure conditions may also be used. Maximum losses would need to be established.
- Modify the loaded wheel and sand adhesion tests. Bleeding is normally due to errors or failing to take temperature and traffic into account; this will be avoided by incorporating variable conditions of load and temperature in this test.

Step 4 Long Term Tests

- The main failure modes would be addressed:
 - Cracking
 - Rutting
 - Moisture damage
- Abrasion WTAT.
- Rutting: Wheel tracking test with water.
- Fatigue on section about 40-50mm in length (strain controlled).
- Testing would be done for high, low, and medium.
 - Traffic (loading)
 - Temperature
 - Humidity

Step 5 Field Type Tests

- Field Cohesion: measuring resistance to penetration or a shearing torque. This would be for traffic time and for use after 24 hours. Results would require establishment of minimums for field QC, but NOT be mix design parameters.
- Field surface texture measurement by sand patch test or some other texture measurement devise.

New: The above draft was modified after further discussions between Ms. Goldman and Mr. Holleran. A draft of the experimental matrix has been prepared and will be discussed at the upcoming team meeting in Sacramento. Ms. Goldman has finished translation of an instrumented German mixing test that shows promise. The team will determine the availability of the device and associated cost.

Planned: The Phase II and Phase III work plans will be further debated and enhanced at a project team meeting scheduled for Nov. 18-19 in Sacramento.

PHASE II Mix Design Procedure Development

Task 3 – Evaluation of Potential Test Methods

No Activity

Task 4 – Evaluation of Successful Constructability Indicators

No Activity

Task 5 – Ruggedness Tests of Recommended Equipment and Procedures

No Activity

Task 6 – Phase II Report

No Activity

PHASE III Pilot Projects and Implementation

Task 7 – Evaluation of Potential Test Methods

No Activity

Task 8 – Workshop Training Program/Pre-Construction Module

No Activity

Task 9 – Pilot Projects/Procedure Validation

No Activity

Task 10 – Final Report

No Activity

NEXT MONTH'S WORK PLAN

The activities planned for next month are listed below.

- Coordinate with CALTRANS personnel on an as needed basis
- Continue reviewing the documents selected for literature research and acquire the documents currently not available. Continue with the development of the draft literature report.
- Continue development of Phase II and Phase III work plans.
- Team meeting on November 18-19 in Sacramento.

PROBLEMS / RECOMMENDED SOLUTIONS

The literature review is consuming more time and effort than originally estimated. Given the importance of this first task for the project as a whole, funds from Phase I, Task 2 are used to accommodate the increased effort in Phase I, Task 1. This will not affect the overall project costs or the timely and within budget completion of Task 1.